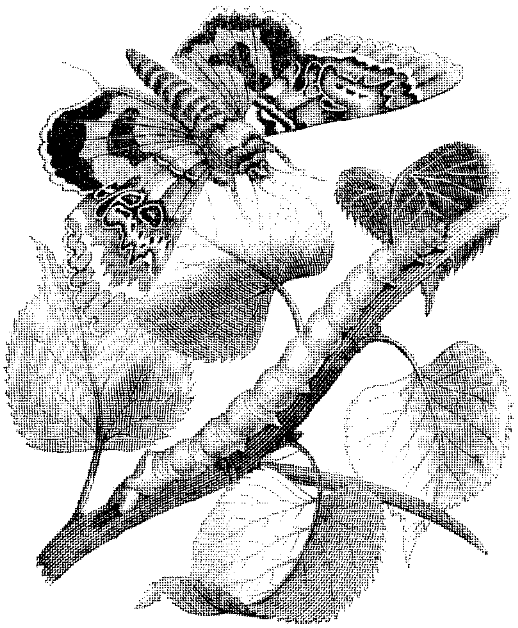
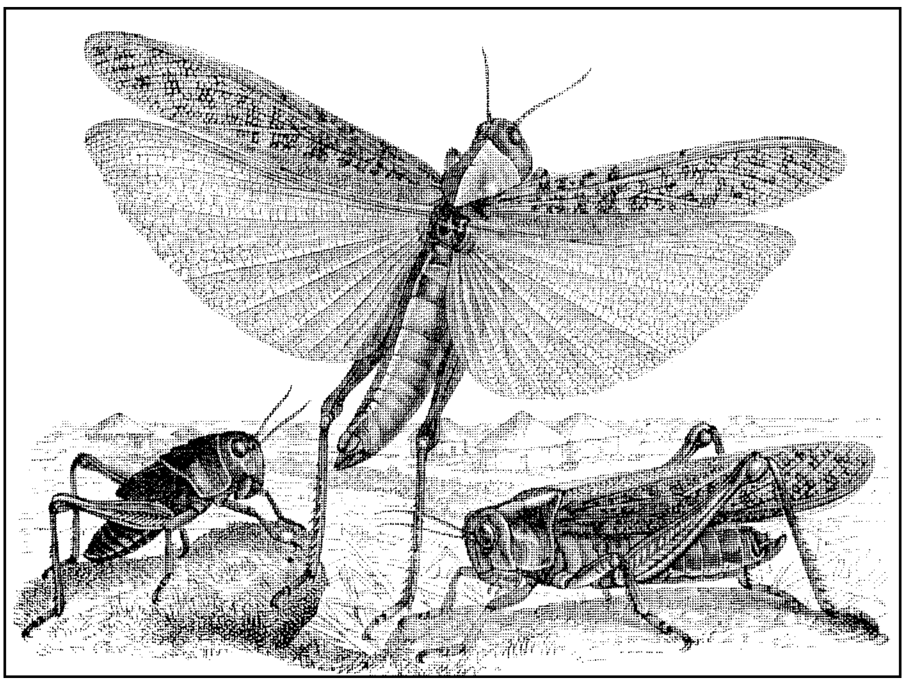


Introduction to the Identification of Insects and Related Arthropods - 2003

P. M. Choate



"Much of our usual appreciation of an animal - in any condition - depends on our ability to identify and name it..."
R. M. Knutson (1987), "Flattened Fauna."

Identification Key to the Classes of Adult Arthropoda

Insects represent one **Class** of animals within the **Phylum *Arthropoda***. If you do not immediately recognize an insect you may need to identify some arthropods to first determine if they are in fact insects before proceeding further.

Biologists have adopted the use of *dichotomous keys* to identify organisms. Starting at couplet 1, decide which of the first 2 choices best fits the organism you are trying to identify. Proceed by going to the couplet indicated at the end of your choice. By process of elimination you will arrive at an identification. Compare your results with pictures and notes in this handout and in your books to see if you have arrived at a likely identification. If you are satisfied with your result, proceed to the next key that you wish to use and follow the same process. As you move from **Class** to **Order** to **Family** and perhaps to **Genus** and **Species** you will notice that choices may become more difficult. This is due to the details necessary to separate these categories. Since this key is designed to help you recognize insects, and to also recognize Arthropods that might be confused with insects, we will start with an obvious and surefire couplet, #1. There are many insects which do not appear to have wings or actually lack wings. However, many have easily observable and functional wings which immediately identify the creature as an insect.

1. With 1-2 pair of obvious, visible, usually transparent wings (**Fig. 1**). (*If it's not a bird or a bat then it is an insect*) .... **Insecta**

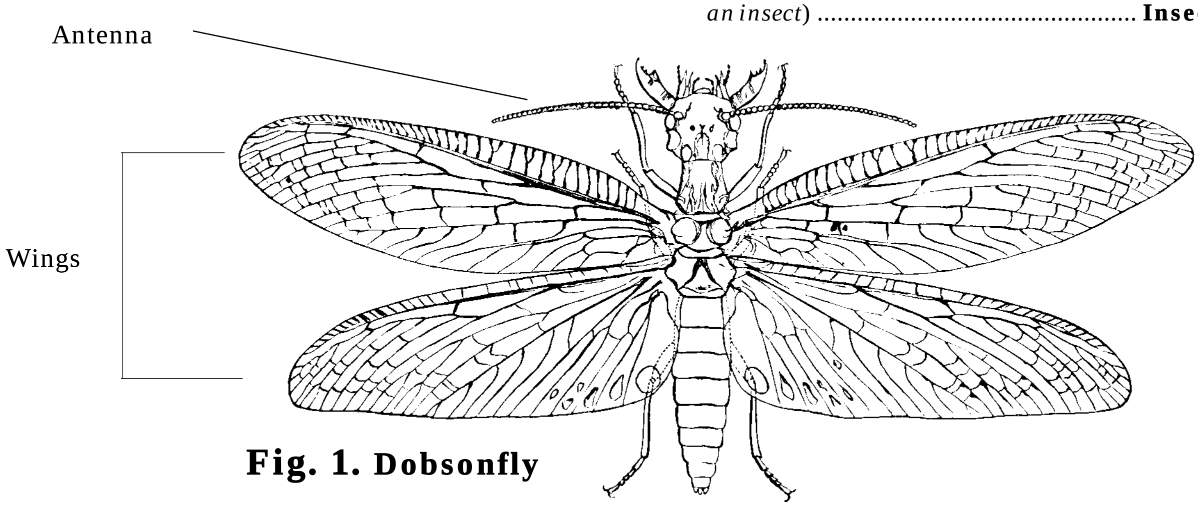


Fig. 1. Dobsonfly

\- Without obvious wings 2

2. With 1 or 2 pairs of antennae ("segmented feelers") of various shapes (see **Figs. 1, 3-5**) inserted on front of head, usually between the eyes. Antennae may be inconspicuous, hidden beneath head when viewed from above, or small and more bristle-like than typical segmented structure. ***Note***: some non-insects carry their front legs or modified mouthparts (pedipalps, **Fig. 2**) in a manner resembling antennae 3

\- Lacking segmented antennae and always lacking any suggestion of wings. 8

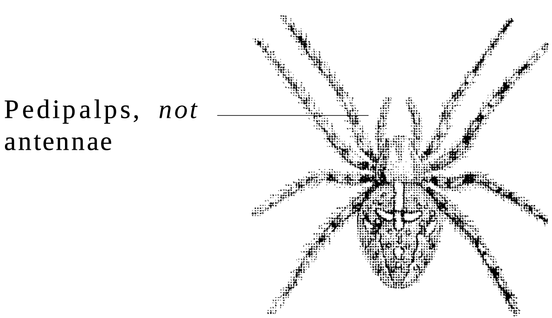


Fig. 2. Spider

3. With 2 pairs of antennae (one pair may be smaller than the other; *2nd pair is vestigial in terrestrial Isopoda* (pillbugs, **sowbugs**); body usually with 2 distinct regions (**Figs. 3-4**), **cephalothorax** and

abdomen; variable number of legs on cephalothorax, abdomen with or without appendages which when present are not leg-like; (amphipods, sowbugs, lobsters, crayfish) .... **Crustacea**

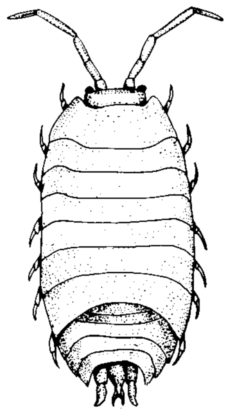


Fig. 3. sowbug

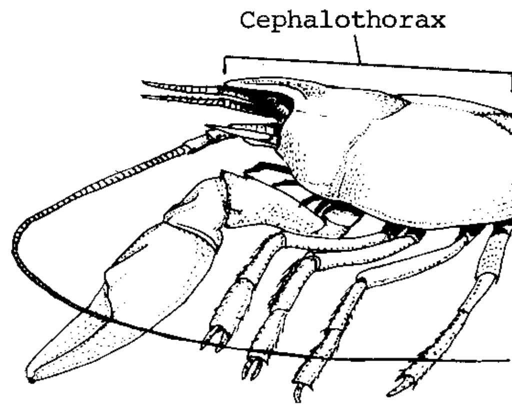


Fig. 4. Crayfish

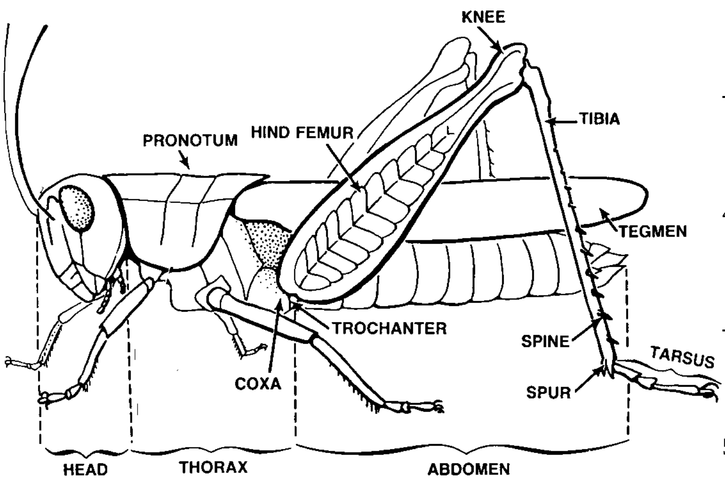


Fig. 5. Grasshopper

- **Always** with **only 1 pair** of antennae; body regions and numbers of legs variable; appendages not biramous 4

4. With only 3 pairs of legs and often with 1-2 pairs of wings; 3 body regions (**Fig. 5**). Abdomen without segmented legs but may have appendages; body shape variable .... **Insecta**
- With 9 or more pairs of legs (**Figs. 6-7**) which are on most segments posterior to head; head distinct; wings absent; body elongate and wormlike 5

5. Legs evenly spaced along body, usually 1 pair of legs per segment 6
- Legs arranged in pairs, 2 pair per segment (**Fig. 6**)(millipedes) .... **Diplopoda**

6. Body flattened, with 15 or more pairs of legs; size variable but usually longer than 25mm.(**Fig. 7a**)(centipedes) .... **Chilopoda**
- Body cylindrical; *minute* forms with 9-12 pairs of legs 7
7. Antennae branched (**Fig. 7b**); 9 pairs of legs .... **Pauropoda**
- Antennae not branched; 10-12 pairs of legs (**Fig. 7c**) .. .. **Symphyla**

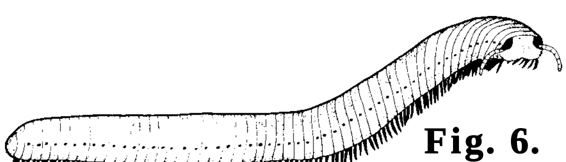


Fig. 6. Millipede

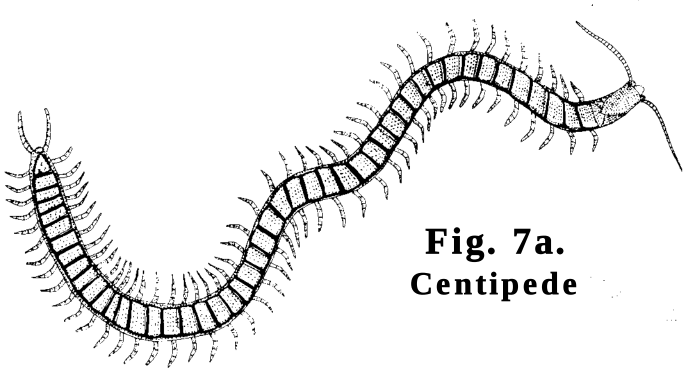
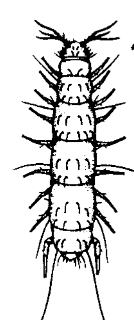
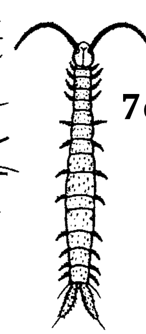


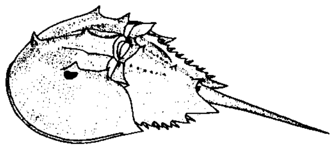
Fig. 7a. Centipede



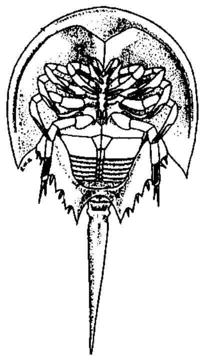
7b. Pauropod



7c. Symphylan



7d. Horseshoe crab

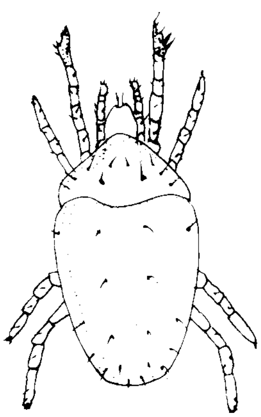


8. Usually 7 pairs of appendages, 5 pairs of legs; *marine organisms only*; abdomen rudimentary .... **Pycnogonida**
- Six (rarely fewer) pairs of appendages, with 4 (-5) pairs of legs; abdomen well developed 9

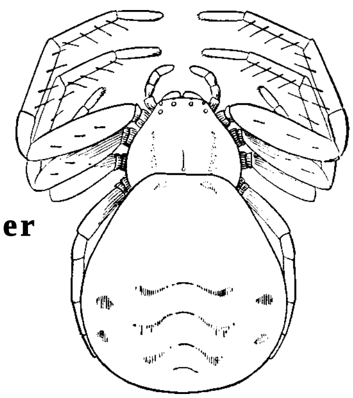
9. Large marine forms up to 460mm in length; body oval, covered with hard shell; long spinelike tail present. (Horseshoe crabs. **Fig. 7d**) ....**Xiphosura**
- Smaller forms, less than 75mm in length; body without hard shell and without spinelike tail; *See below*. (spiders, ticks, mites, whip scorpions, windscorpions, scorpions) .... **Arachnida**

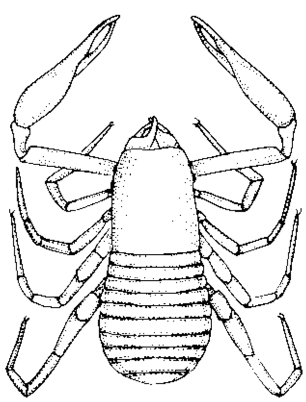
Some Arachnids

Mite



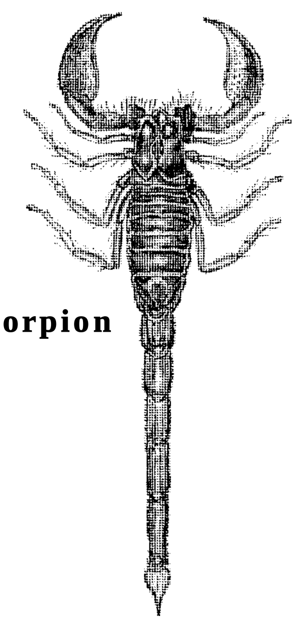
Crab Spider

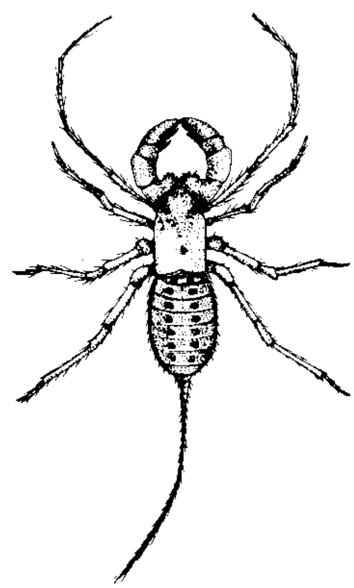




Pseudoscorpion

Scorpion





Vinegaroon

Key to the Orders of InsectsNormally Found in Insect Collections

Once you have determined that the organism you have before you is an insect you may wish to further identify it. This means that you may have to use additional keys to determine the **Order** of that specimen. Some insects will be immediately recognized as insects but you may not be familiar with the oder to which it belongs. The key that follows will help you determine many of the more commonly encountered orders of insects. Not all insects will be able to be determined here. If you decide that your specimen may not be included here, use the reference books. These should permit identification of any specimen you happen upon.

Once you have determined the **Order**, the next step is to determine the **Family** within that order to which the insect belongs. This may mean an increase in complexity for you, and will usually require additional knowledge about specific types of structures and the variation that exists within these structures. Once the family of an insect has been determined you are left to hunt for literature that will permit identification to genus and species. Not only may this prove difficult, it may prove impossible. Not all insects are discussed or are identifiable to species. Literature may be scattered, outdated, or non-existent. You may have to call upon specialists for help. This is a normal part of the identification process. For our purposes here we will concentrate upon keys that should help you arrive at an **Order** level identification, and within a few of these Orders, some of the more commonly encountered families.

The following key to orders begins with a couplet that asks you to determine whether or not the insect has wings. This may be a confusing beginning for you. Many insects have flight wings which are hidden beneath another set of modified wings called **elytra** (*see examples on **page 10***). Elytra are wings which act as protection and covering for the flight wings of beetles. At first glance there is little to indicate to you that these insects have wings. To further confuse the issue there are many beetles that lack flight wings, and whose elytra are fused to form a solid cover. Similar modifications may occur in such diverse groups as grasshoppers and the true bugs.

A similar point of confusion may be the determination of presence or absence of antennae. **Antennae** come in a variety of sizes and shapes (*see **pages 11-13***). Dead insects may have antennae hidden or broken. If antennae are not apparent check to see if attachment "sockets" are visible on the insect's head in front of and beneath the eyes.

These two characters (antennae and wings) are mentioned here to emphasize the point that it is almost impossible to generalize about the characteristics that make up an insect order. There are many exceptions. With this in mind, proceed to identify specimens, using your book and examples here to help arrive at your final determination. When you have finished you should go to a museum or reference collection and compare your results. With practice you may find that the identification of insects will become a challenging avocation.

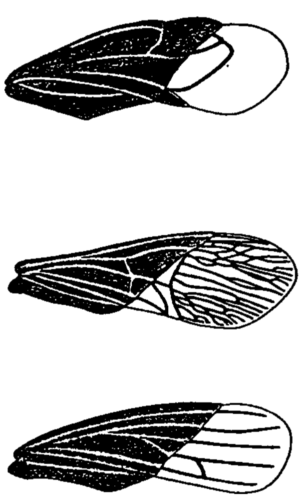


Fig. 8. Hemelytra

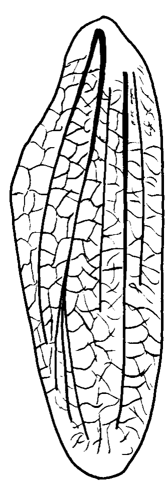


Fig. 9. Tegmen

1. Wings present (wings may be hidden under external elytra (p. 10-11), hemelytra (Fig. 8), or tegmina (Fig. 9) such that "wings" do not appear to be present)..22

— Wings absent or reduced to small pads; many abdominal segments visible from above 2

2. Antennae absent; body slender and whitish in color. Very small (Fig. 10) (1mm.) .... **Protura**

— Antennae present (may be difficult to see) 3

3. Usually with forked spring (furcula - Fig. 11)on abdomen. Size small, 2-4mm. Always lacking apical abdominal cerci. If furcula absent, size and body shape are characteristic of order .. **Collembola**

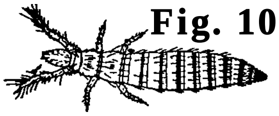


Fig. 10. Protura

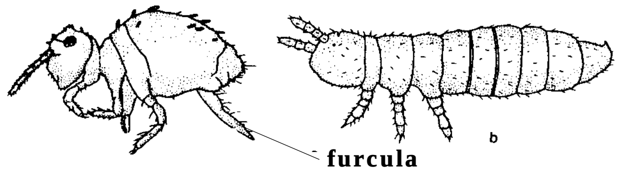


Fig. 11. Collembola

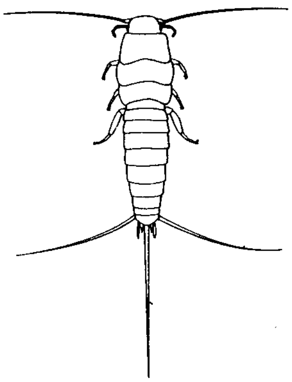


Fig. 13. Thysanura

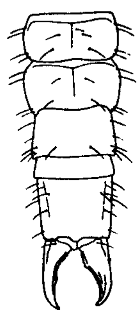


Fig. 12. Diplura

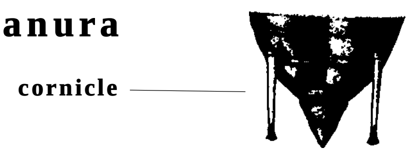


Fig. 14. Homoptera

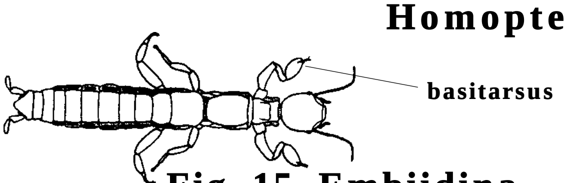


Fig. 15. Embiidina

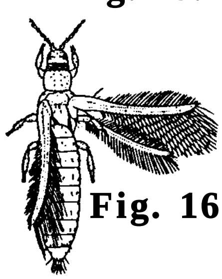


Fig. 16. Thysanoptera

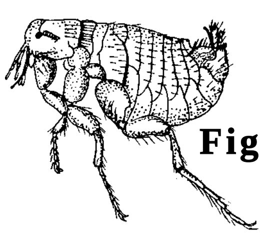


Fig. 17. Siphonaptera

— Furcula always absent. Body size larger, shape various 4

4. Apex of abdomen with long cerci (Fig. 13) and lacking ventral abdominal styliform appendages, or if ventral styliform appendages present, cerci are short 5
— Cerci short or lacking; abdominal styliform appendages always absent 6

5. Apex of abdomen with 3 filamentous cerci (silverfish) .... **Thysanura**
— Apex of abdomen with 2 cerci, either forceps-like (Fig. 12) or short and segmented .... **Diplura**

6. Large unsegmented forceps-like structures at apex of abdomen(earwigs) .... **Dermaptera**
— Cerci (when present) neither forceps-like nor unsegmented 7

7. Large insects, usually > 25mm in length; antennae frequently very long and slender 8
— Small insects, usually < 12mm in length 9

8. 4-segmented tarsi .... **Orthoptera**
— 5-segmented tarsi .... **Phasmida**

9. Tube-like structures (cornicles) (Fig. 14)protruding posteriorly from 4th to last abdominal segment; *OR* body covered with waxy filaments or a scale .... **Homoptera**
— Cornicles absent *AND* no scale or waxy filaments covering body 10

10. Abdomen constricted to narrow waist where it joins thorax (bees, wasps, ants, sawflies) .... **Hymenoptera**
— Abdomen not constricted into narrow waist 11

11. Front legs with enlarged first segment (Fig. 15) (basitarsus), which is modified for production of silk (webspinners) .... **Embiidina**
— First tarsal segment not enlarged 12

12. Mouthparts (rasping-sucking) contained in a short, cone-like beak; wings when present often with fringe of hairs (Fig. 16); size <3mm; abdomen often pointed at apex (thrips) .. **Thysanoptera**
— Mouthparts other than rasping-sucking; may be in form of elongate beak which extends ventrally and posteriorly beneath head; 13

13. Body flattened laterally, with numerous backward-projecting spines and bristles; legs long, with greatly enlarged coxae modified for jumping (fleas) (Fig. 17) .... **Siphonaptera**
— Body not flattened laterally; may have hairs or spines but these are not backwards projecting; if legs are modified for jumping, femora are enlarged 14

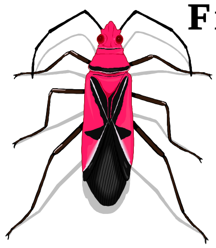


Fig. 18. Heteroptera

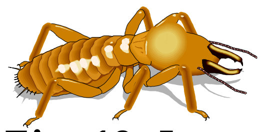


Fig. 19. Isoptera

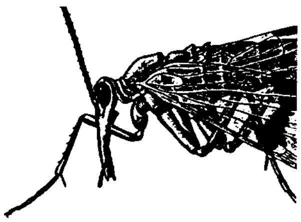


Fig. 20. Mecoptera

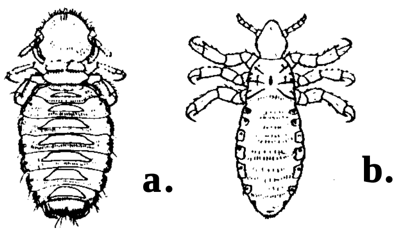


Fig. 21

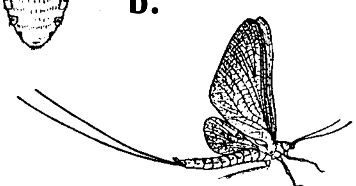


Fig. 22. Ephemeroptera

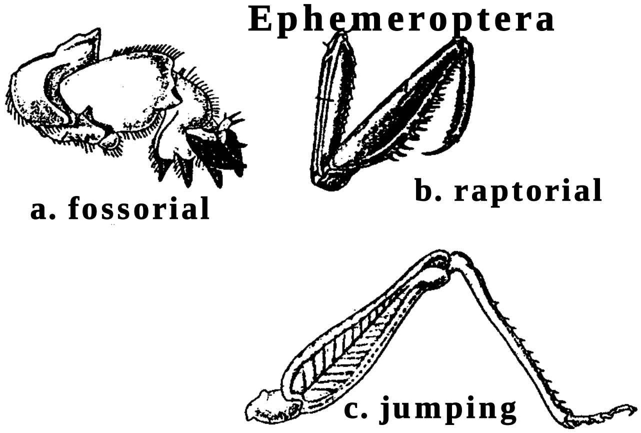


Fig. 23. Orthoptera leg types

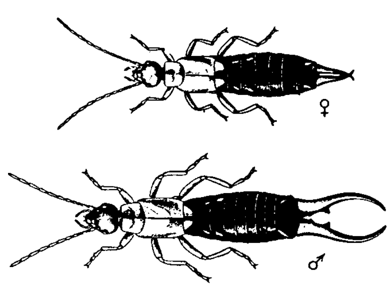


Fig. 24. Dermaptera

14. Mouthparts elongated into piercing-sucking beak 15
— Mouthparts not elongated into long piercing beak; head may be prolonged 16

15. Antennae hidden in grooves in head .... **Diptera**
— Antennae long and easily seen (Fig. 18)**Heteroptera**

16. Body covered with dense hair ....**Lepidoptera**
— Body lacking dense hair 17

17. Antennae moniliform (segments beadlike); short cerci present (Fig. 19)(termites) .... **Isoptera**
— Antennae not moniliform; cerci absent 18

18. Antennae long and slender 19
— Antennae short 20

19. Head prolonged and beak-like (Fig. 20); males of some species have scorpion-like abdomen (scorpionflies) ....**Mecoptera**
— Head not prolonged and beak-like .... **Psocoptera**

20. Tarsi with 4-5 segments .... **Diptera**
— Tarsi with 1-3 segment (lice) - **Phthiraptera** 21

21. Chewing mouthparts; head usually broader than long (Fig. 21a) .... **Mallophaga**
— Piercing-sucking mouthparts retracted into head; head usually longer than broad; legs greatly enlarged for grasping (body lice)(Fig. 21b) .... **Anoplura**

22. Abdomen with large unsegmented forceps-like cerci (Fig. 24)....................................... **Dermaptera**
— Cerci appearing segmented when present, not forceps-like, or absent 23

23. Cerci filamentous, longer than last 3 abdominal segments combined 24
— Cerci shorter than last 3 abdominal segments combined, not filamentous, or totally absent 28

24. Wings folded upright and parallel to body length; antennae setaceous (Fig. 22. mayflies) .... **Ephemeroptera**
— Wings various but not held upright above body; antennae elongate and filiform 25

25. Front pair of legs shaped differently than mid and hind pair, modified for digging (Fig. 23a) (fossorial) or grasping (Fig. 23b) (raptorial) .... **Orthoptera**
— Front pair of legs similiar to middle pair 26

26. Hind pairs of legs enlarged for jumping (Fig. 23c).... .... **Orthoptera**
— Hind pair of legs similar to middle pair 27

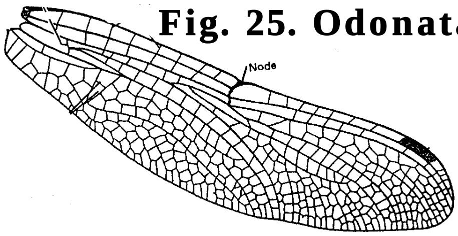


Fig. 25. Odonata wing

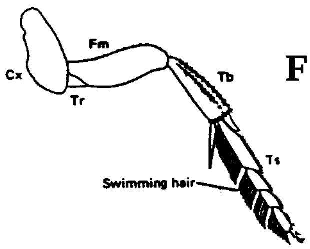


Fig. 26. Aquatic Heteroptera

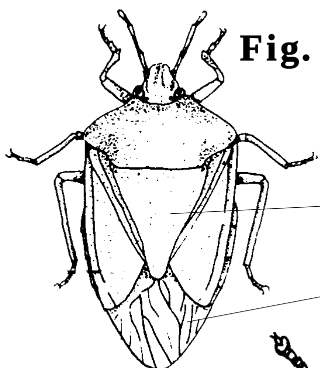


Fig. 27. Heteroptera

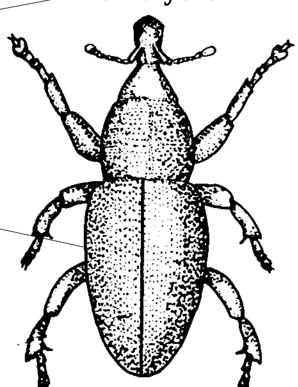


Fig. 28. Coleoptera

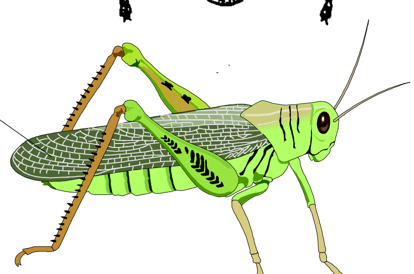


Fig. 29. Orthoptera

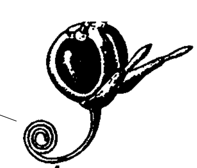


Fig. 30. Lepidoptera

27. Tarsi 3-segmented; cerci long or short, not forceps-like; many segmented .... **Plecoptera**
— Tarsi variable (4-5 segments). Includes large, bulky insects, frequently with well developed wings 31

28. Cerci present, shorter than last 3 abdominal segments combined 29
— Cerci absent (do not be confused by genitalia) 33

29. Small, delicate insects; wings transparent, uniform shape and size 30
— Body shape varied; wings in form of elytra, tegmina, or hemelytra 31

30. Front basitarsi (1st tarsomere) enlarged and dilated to form a webspinning organ .... **Embiidina**
— Front basitarsi not enlarged and dilated, appearing of normal proportions (termites) .... **Isoptera**

31. Tarsi 4-segmented .... **Orthoptera**
— Tarsi 5 segmented 32

32. Prothorax much longer than mesothorax; front legs modified for grasping .... **Mantodea**
— Prothorax not greatly lengthened; front legs not modified for grasping .... **Blattaria**

33. Large insects with 2 pairs of wings; wings usually transparent, each wing with an anterior node (Fig. 25)or notch (dragonflies, damselflies) .... **Odonata**
— Wings variable but lacking anterior node 34

34. One pair of wings; halteres present .... **Diptera**
— Two pairs of wings; halteres absent 35

35. Mouthparts in the form of a piercing-sucking, elongate beak which is mostly held beneath and behind the head; palpi absent 36
— Mouthparts other than above; palpi present 38

36. Hind leg without tarsal claws; adapted for swimming (Fig. 26) .... **Heteroptera**
— Hind leg with tarsal claws 37

37. Beak arises from anterior part of head; forewings usually as hemelytra (Fig. 27) .... **Heteroptera**
— Beak appears to originate from between front pair of legs; forewings of uniform texture .... **Homoptera**

38. Rasping-sucking mouthparts in form of cone-like beak; wings fringed with long hairs .... **Thysanoptera**
— Not as above 39

39. Front pair of wings hardened, of different texture than rear flight wings 40

— Front wings not thickened or hardened to form cover for flight wings 41

40. Front pair of wings thickened and usually hard, without crossveins, meeting along midline (meson) of the body to form elytra (Fig. 28); many forms with elytra shortened, exposing one or more abdominal segment from above (beetles); hind legs usually not modified for jumping .... **Coleoptera**

— Front pair of wings with obvious crossveins and veins (Fig. 29, tegmen), overlapping one another at least partially; hind legs often enlarged for jumping (grasshoppers, crickets, Katydids) .... **Orthoptera**

41. Front basitarsi (1st segment) enlarged to form silk-producing glands (Fig. 15) (webspinners) .... **Embiidina**

— Front basitarsi not any more enlarged than remaining segments 42

42. All wings equal in size; (termites) .... **Isoptera**

— Hind wings usually smaller than front pair of wings; 43

43. Mouthparts in the form of a coiled siphon (Fig. 30); wings and body usually covered with scales (butterflies and moths) ....**Lepidoptera**

— Mouthparts not in the form of a coiled siphon; body scales absent or few in number, restricted to wings and wing veins 44

44. Many crossveins in wings (Fig. 31), particularly at anterior edge; if few crossveins, wings covered with waxy coating and insect very small .... **Neuroptera**

— Few crossveins in wings; body and wings lacking waxy coating 45

45. Mouth reduced, vestigial; only palpi obvious; hairs often present on wings (caddisflies) .... **Trichoptera**

— Mouthparts not reduced or vestigial; chewing or chewing-lapping types 46

46. Chewing mouthparts elongated into a beaklike structure. Some males with scorpion-like abdomen (scorpion flies) ....**Mecoptera**

— Chewing mouthparts not elongated into beak; or with chewing-lapping mouthparts 47

47. Tarsi 4- or 5-segmented; wings folded flat over body (Fig. 32) (bees, wasps, ants, sawflies) .... **Hymenoptera**

— Tarsi 2- or 3-segmented; wings folded roof-like over body (Fig. 33) (treelice, booklice) .... **Psocoptera**

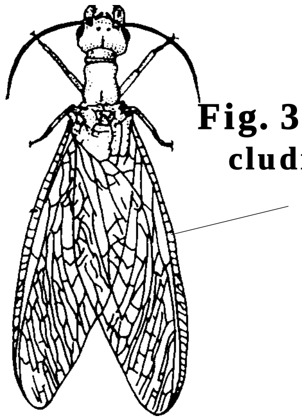


Fig. 31. Neuroptera, including Megaloptera

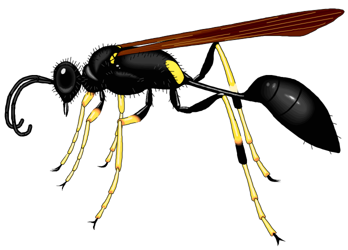


Fig. 32. Hymenoptera

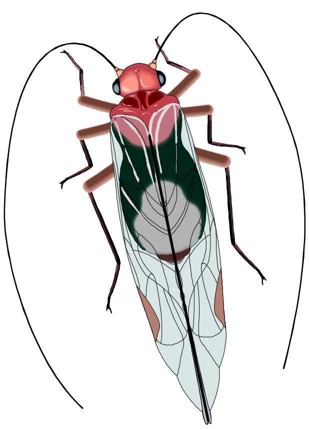
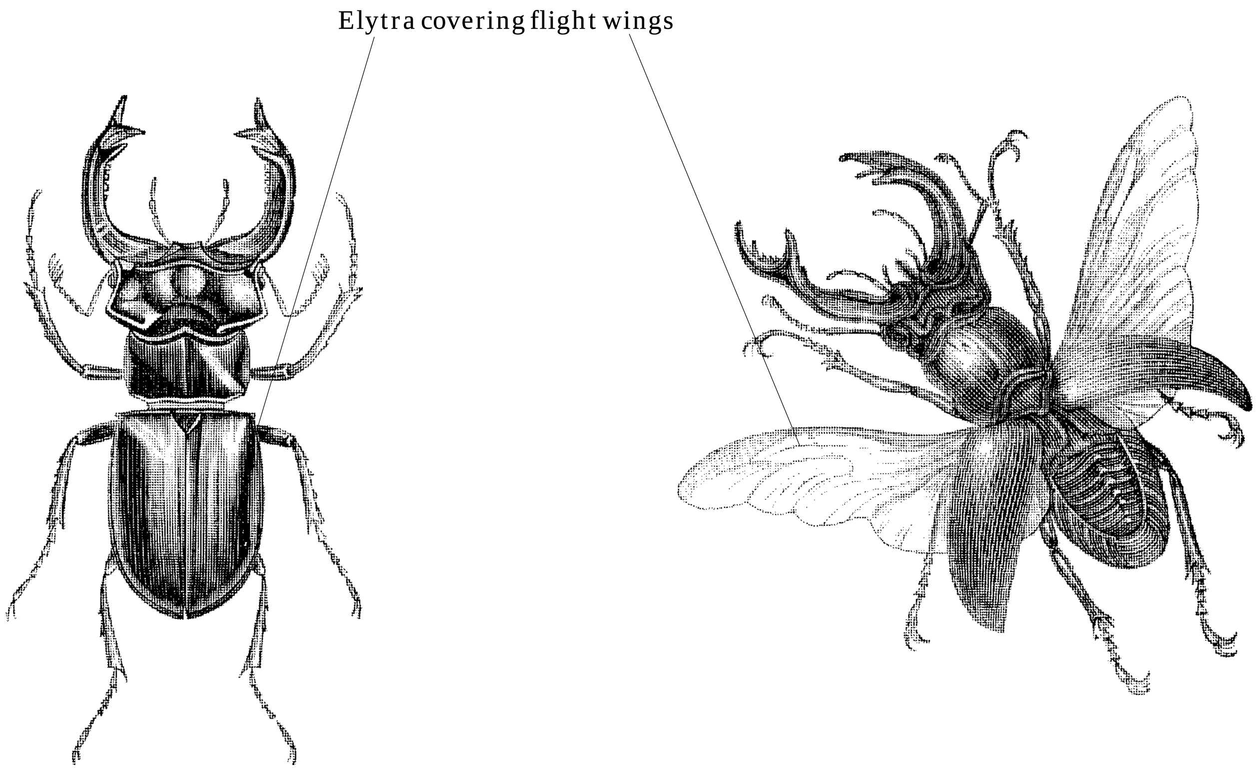
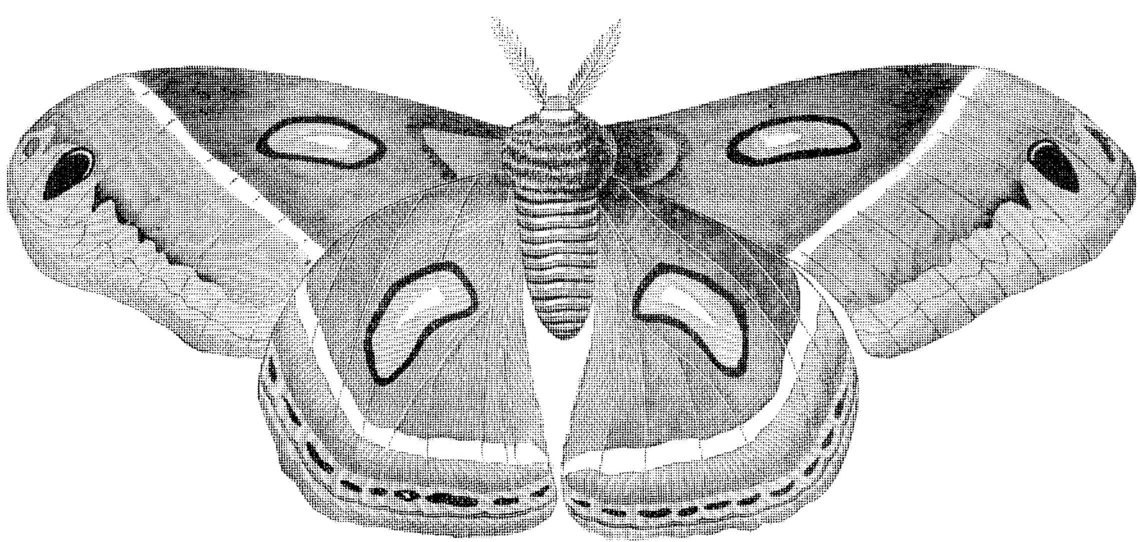


Fig. 33. Psocoptera

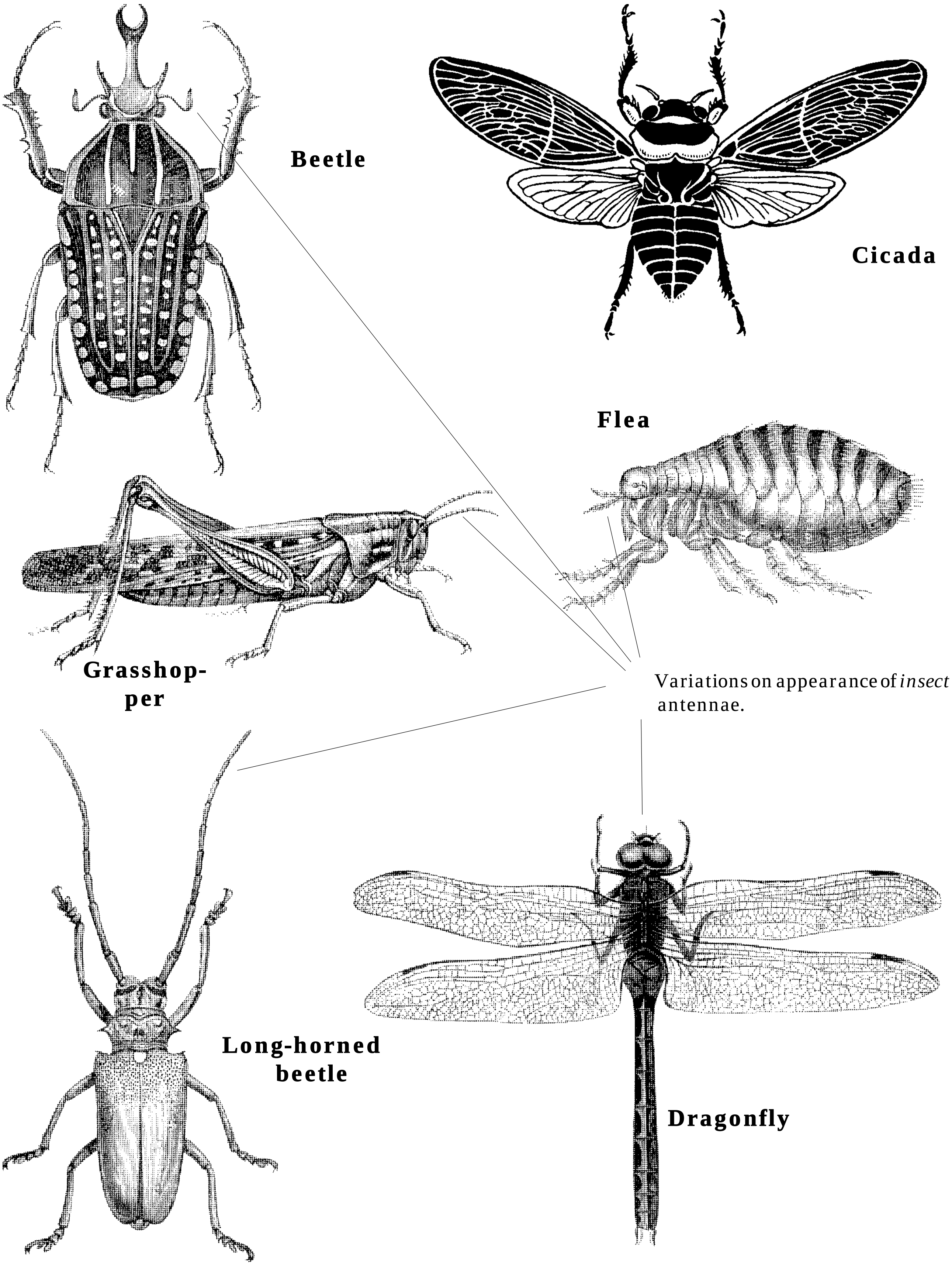


Stag Beetle (Coleoptera: Lucanidae) with elytra closed, appearing to lack "typical" wings.

Stag Beetle (Coleoptera: Lucanidae) with elytra opened, preparing to take flight. Note visible "flight" wings.

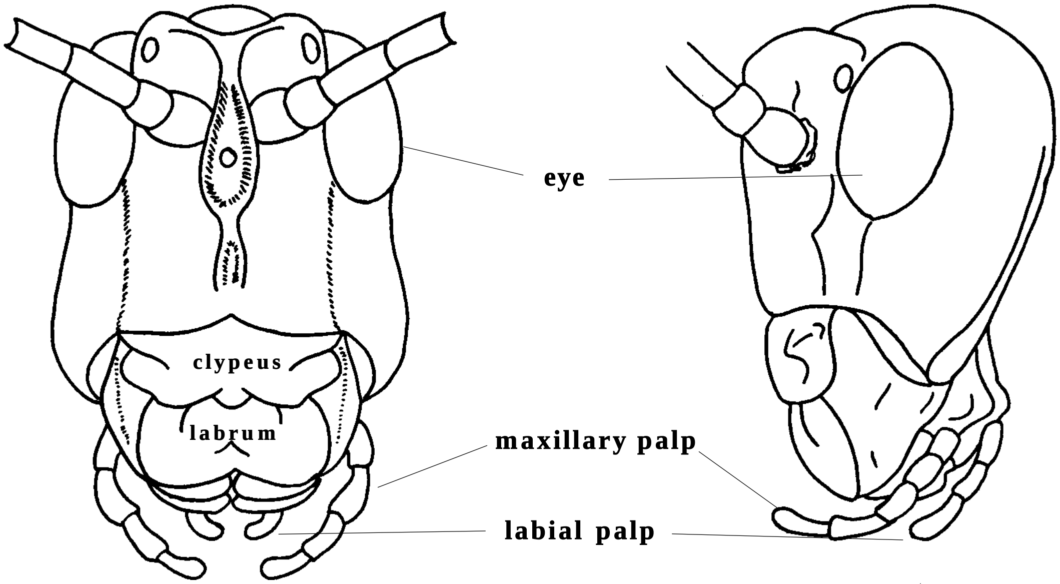


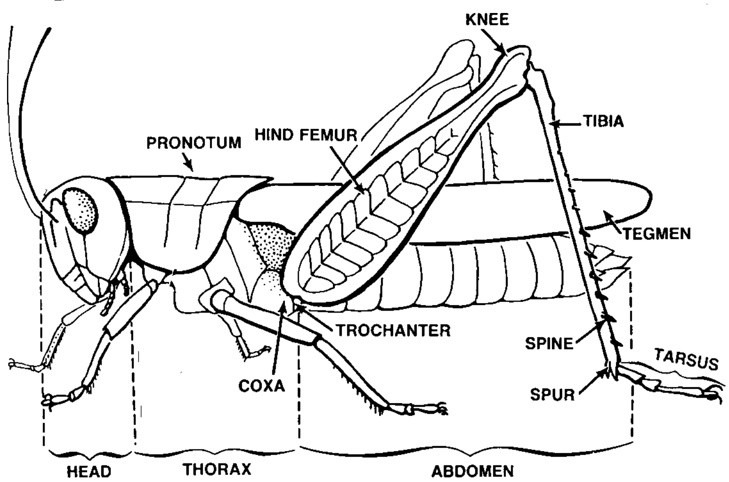
Note "feathery" antennae of this male moth (Lepidoptera).

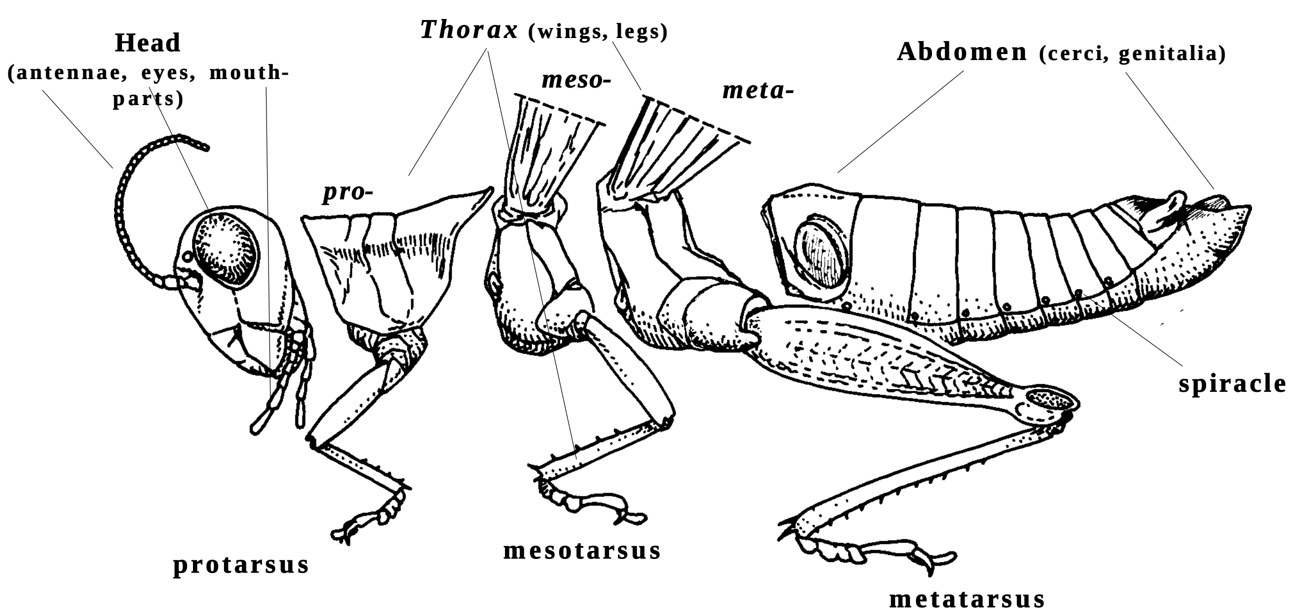


Variations on appearance of *insect* antennae.

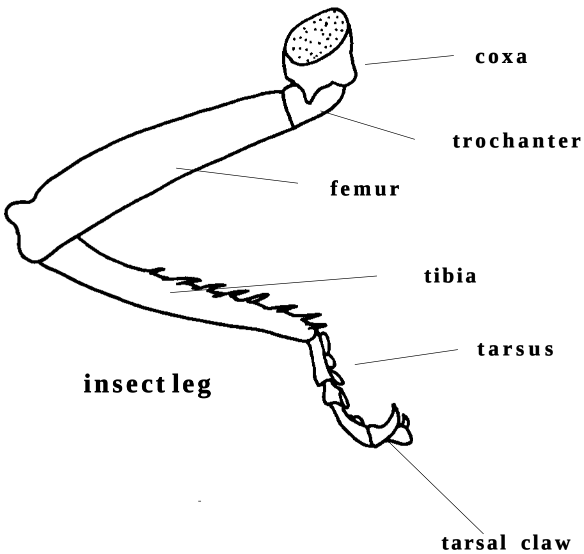
Grasshopper, frontal and lateral view of head.



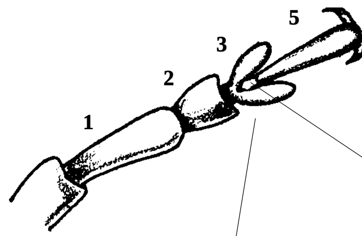




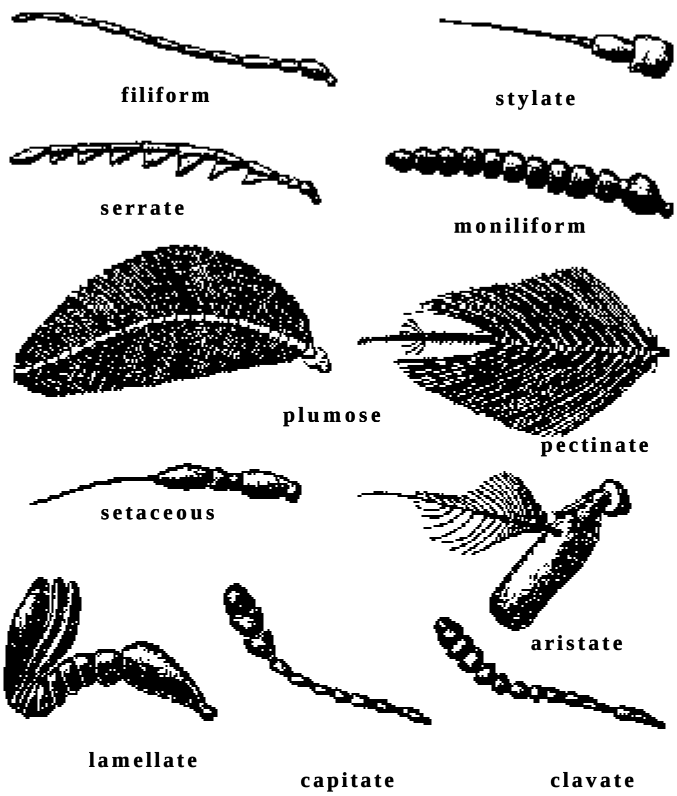
Body regions of grasshopper



insect leg



5 segmented tarsus, with segment 4 "hidden"



A few antennal types